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ABSTRACT

This document describes (1) the development of effectiveness criteria for Air Force Reserve Officer Training Corps (AFROTC), and (2) relationships between the criteria and various environmental and program characteristics. Normative data are presented for selected criteria (enrollment, production, and unit costs) for each school year between 1966 and 1974. Multiple regression techniques were used to determine the extent to which criterion performance was attributable to characteristics of the host college and characteristics of the program. Predictive stability was examined across both institutions and time. Implications of the findings for evaluation of both current detachments and potential host sites are also discussed. (Author/KE)

AFHRL-TR-75-18

AIR FORCE HUMAN RESOURCES LABORATORY

AN ANALYSIS OF AFROTC DETACHMENT VIABILITY

By

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August 1975
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AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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This technical report has been reviewed and is approved.

LELAND D. BROKAW, Technical Director
Personnel Research Division

Approved for publication.

HAROLD E. FISCHER, Colonel, USAF
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This report is one of a series describing: (a) the development of effectiveness criteria for AFROTC detachments, and (b) relationships between the criteria and various environmental and program characteristics. Normative data are presented for selected criteria (enrollment, production and unit costs) for each school year between 1966 and 1974. Multiple regression techniques were used to determine the extent to which criterion performance was attributable to characteristics of the host college and characteristics of the program. Predictive stability was examined across both institutions and time. Implications of the findings for evaluating both current detachments and potential host sites were discussed.

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PREFACE

This research was conducted under Project 7719, Air Force Personnel System Development on Selection, Assignment, Evaluation, Quality Control, Retention, Promotion, and Utilization; Task, 771902, Exploration of Methods for Increasing the Effectiveness of Personnel Programs. The investigation was made in partial response to RPR 73-40; Prediction of AFROTC Detachment Viability, originating at AFROTC/ACME.

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AN ANALYSIS OF AFROTC DETACHMENT VIABILITY

I. INTRODUCTION

Effective management of large and complex organizations requires that considerable effort be made to monitor the progress of individual subunits and to insure the viable operation of the system as a whole. The Air Force Reserve Officer Training Corps (AFROTC) is one such organization. With total enrollments in excess of 27,000 students undergoing instruction at 180 detachments throughout the United States, the AFROTC program has for several years been the principal source of Air Force commissioned officers.

In the late 1960's, a research program was initiated at the request of Hq AFROTC to develop improved methods of evaluating detachment viability. Until that time, the detachments were judged primarily on the basis of near term performance measures: annual graduate production and associated unit costs. There was a growing awareness, however, that there might be qualitative differences in detachment output which would not become evident until after entry to active duty. Mean aptitude levels of graduates from various detachments, for example, would effect attrition in subsequent technical training programs. Other characterisites of detachment cohorts might influence, in part, how well they perform on the job and ultimately whether or not they elect to become career officers. Thus, a principal goal of this effort was to extend the evaluation system so that both near and long term unit effectiveness criteria could be monitored over time.

Aside from requirements for an enhanced criterion package, research was also needed to identify and investigate the principal correlates of criterion performance at the detachment level (i.e., institutional size, geographic location etc.). Definitive analyses of this type could lead to improved capability in predicting and/or controlling detachment effectiveness as required for successful management.

Previous research in this area has served mainly to establish the basic feasibility of such an approach (Tupes, Dieterly, Fortuna & Madden, 1968; Tupes & Madden, 1968, 1970; Alley, 1974). The data base used in these studies was limited for research purposes to input groups entering service prior to 1964. As a result, most of the production, cost and training criteria were somewhat dated for operational use. There were also certain assumptions made in these studies about linearity of functional relationships and predictive stability across time that required additional verification.

A requirement now exists for updating the system to include information on all officer assessions from 1964 to the present. Due to the magnitude of the data collection effort, the work was divided into two phases. Phase I involved the accumulation and analysis of the most recent detachment effectiveness criteria available from AFROTC. Most of the near term enrollment, production and unit cost criteria from 1964 to 1974 fell into this category. Phase II consisted of a more comprehensive update of the data base in which the remaining long term criteria (i.e., input quality, training success, job performance and retention) would be generated.

The purpose of this report is to present the interim results of these analyses. The principal research questions addressed in the study can be summarized as follows:

a. To what extent are there stable differences in detachment performance across criteria and across time? The intent was to assemble data and develop normative statistics for each of the available criteria from 1964 to 1974, and to determine if there was sufficient stability in these measures for long term forecasting purposes. It was recognized that some of the criteria would remain relatively invariant over time while others would not. Those that appeared inconsistent in Time 1/Time 2 comparisons (i.e., were sensitive to relatively short term influences or modifications in the operation of a detachment) might be useful in making comparisons between existing detachments, but would be of little value in forecasting the viability of a proposed detachment site. Highly stable criteria on the other hand which presumably reflected more enduring characteristics of the detachment or the surrounding environment could conceivably serve both purposes.

b. To what extent can differences in detachment performance be attributable to influences beyond management control? The answer to this question also has several important implications for the evaluation of both current detachments and potential host sites. If, for example, detachment performance was functionally related to characteristics of the institution at which it operated, then a more equitable

evaluation procedure could be implemented which controlled for these factors. Evaluation procedures for potential host sites would also be enhanced if supporting documentation could be developed which indicated that the observed relationships were stable enough to generalize to new institutions at some future time period.

c. To what extent can differences in detachment performance be attributable to controllable features of the AFROTC program? By estimating the influence of these factors, both unique and joint contributions in the context of the other variables, management decision makers would be in a better position to evaluate program modifications and their expected consequences on the performance criteria.

II. APPROACH

The Criterion Package

Detachment effectiveness criteria used in the analysis can be grouped into four broad categories: (1) enrollments – based on the number of students enrolled in AS100 through AS400, (2) production – based on the total number of graduates in a given year, (3) costs – derived from unit costs associated with graduation from AFROTC, and (4) overall viability – based on the relative success of the detachments in maintaining a viable program between 1964 and 1974. The criteria are summarized in greater detail in Table 1. Normative distributions, means and standard deviations for the criteria based on the most recent data available are shown in Appendix A. The first set of tables (Tables A1) gives detachment frequency distributions for AS100 through AS400. Detachment enrollments in AS100 vary from less than 10 to more than 200 cadets. The majority of the units fall within the range of 21 to 30 enrollees. Enrollments in AS200 through AS400 are considerably less with most units having 16 to 20 people enrolled in each of the three programs. The data from Table A2 indicates that graduate production ranged from less than five to more than 70 graduates with an average of approximately 21 per detachment. Considerable differences between detachments can also be noted on the unit cost and total cost criteria. To provide a historical perspective for these measures, means, standard deviations and mean correlations between years for the criteria between 1966 and 1974 are shown in Table 2. The trend during this time has been a decline in graduate production from an average of about 36 in 1966 to 24 in 1972. During the same period, costs have increased from an average of $5,381 per student to approximately $15,217. The mean intercorrelations between years indicate that the enrollment production and total cost criteria are quite stable over time while the unit costs are much less stable.

Table 1. Detachment Effectiveness Criteria[a]

Enrollment Criteria	Abbreviated Title
1. AS100 Enrollment	AS100 ENR
2. AS200 Enrollment	AS200 ENR
3. AS300 Enrollment	AS300 ENR
4. AS400 Enrollment	AS400 ENR
Production Criteria	
5. Graduate Production	No of Grads
Unit Cost Criteria	
6. Cost per Graduate, Incl CSP and FIP[b]	Cost per Grad (I)
7. Cost per Graduate, Excl CSP and FIP	Cost per Grad (E)
Total Cost Criteria	
8. Total Detachment Cost, Incl CSP and FIP	Total Det Cost (I)
9. Total Detachment Cost, Excl CSP and FIP	Total Det Cost (E)
Viability	
10. Viability; based on successful operation during 1964 – 1974	Viability

[a]Except for the enrollment criteria, these measures are available for each year of operation between 1964 and 1973. Enrollment data are available from 1964 – 1973.

[b]CSP refers to textbook costs associated with the College Scholarship Program. FIP refers to costs associated with the Flight Instruction Program.

Table 2. Means, Standard Deviations and Mean Correlations Between Years of Detachment Criteria (1966–1973)[a]

School Year	Detachment Criteria													
	AS100 ENR		AS300 ENR		No. of Grads		Cost per Grad (I)		Cost per Grad (E)		Total Det Cost (I) (in ten thousands)		Total Det Cost (E) (in ten thousands)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
1966–1967	249	230	41	26	36	20	5,381	2,074	NA	NA	18.40	10.45	NA	NA
1967–1968	203	206	31	15	35	21	6,211	2,380	NA	NA	19.13	9.72	NA	NA
1968–1969	188	195	33	17	30	15	7,390	2,494	NA	NA	20.49	9.72	NA	NA
1969–1970	120	139	33	18	28	14	8,918	3,090	NA	NA	21.82	6.82	NA	NA
1970–1971	85	100	32	18	27	16	9,570	3,360	7,896	2,900	22.76	8.31	18.46	6.34
1971–1972	67	47	28	18	27	16	11,506	3,898	9,018	3,018	26.44	10.38	20.48	7.58
1972–1973	56	37	24	13	24	16	15,217	10,375	11,764	8,167	27.08	9.94	20.68	6.95
1973–1974	44	34	25	15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mean Correlation Between Years	.81		.82		.85		.37		.39		.96		.95	

Note. — NA = Not available.

[a]Valid N for every criterion except AS100 ENR included all detachments in continuous operation between 1966 and 1973 (N = 148). Normative data for AS100 ENR excluded "2 year only" detachments (N = 129).

The Predictor Package

For purposes of this study it was useful to distinguish two sources of potential influence on the criteria: (a) environmental characteristics, and (b) program characteristics. The environmental variables define the institutional context in which the detachment must operate. They index the relative quantity and quality of student resources from which the cadet population is typically drawn.

The major sources of basic data for this category of predictor are Astin (1965) and information provided by the Office of Education, Department of Health, Education and Welfare (HEW). The Astin variables shown in Table 3 describe various specific features of a college including freshman input factors, size, estimated selectivity, and professional degree orientation as reflected by the relative number and types of degrees conferred. These variables are in the form of T scores with a mean of 50 and a standard deviation of 10. Information from HEW included geographic region, type, and control of the college or university. These data were coded in sets of mutually exclusive categorical variables where a college was assigned a value of 1 if the characterization applied; zero otherwise.

Program characteristics, in contrast to environmental characteristics, are controllable features of the detachment at least from the standpoint of AFROTC management. These variables define the operating characteristics of the detachment itself whether it is a two-year or four-year program and whether or not it is collocated with a detachment from the other services. To the extent the program influences can be shown to determine effectiveness of the detachments, AFROTC management will be in a better position to select from among various planning options so that program viability, however defined in terms of the effectiveness criteria, can be maximized.

The Analysis

The analysis consisted of model definition and testing by multiple regression methods as outlined by Ward and Jennings (1973). The units of observation were detachments operational in a given time period. Documentation of results was obtained in the form of means, standard deviations, correlations, model regression weights and F statistics. The overall conceptual model for analyzing the environmental and program correlates of each criterion can be characterized as follows:

$$(DC_p) = (EC) + (PC_p)$$

where DC_p are detachment criteria for year p,

EC are environmental characteristics and

PC_p are program characteristics for year p.

Within a given year, the detachment records were analyzed separately for two random split-half samples and for the total sample. The half-sample analyses provided cross validation statistics across schools and, when the model regression weights were applied to data from adjacent years, cross validation statistics across time. Results from the total sample of detachments provided working models for the system.

III. RESULTS AND DISCUSSION

Estimating Detachment Performance from Environmental Characteristics

Table 4 shows the results of the full sample regression analysis using environmental characteristics to predict the most recent detachment performance criteria. The Astin variables alone produced significant multiple correlations ($p<.01$) with every criterion except *AS100 Enrollment*. Significant correlations ranged from a high of .59 in the prediction of *Total Detachment Costs* to .51 for *Cost per Graduate (E)*. Models containing only HEW variables were statistically significant for all of the enrollment, production and cost criteria. These data suggest that, while such factors as institutional size and selectivity may be only marginally related to freshman enrollments, they do account for appreciable differences in the remaining criteria. Moreover, performance on all of the criteria appears to be related to the geographic location, type and control of the host institution.

Table 3. **Predictor Variables**

Environmental Characteristics (EC)

ASTIN Variables

1. Intellectualism (INT) – a combined measure of the academic ability of the student body and motivation for graduate school.
2. Estheticism (EST) – a measure of interest and achievement (during high school) in literature and art.
3. Status (STA) – an indicator of high socioeconomic background and motivation toward a career in business, politics, or law.
4. Pragmatism (PRA) – a measure of motivation towards careers in engineering, agriculture, or physical education.
5. Masculinity (MAS) – primarily based on the percentage of male students and on a high percentage motivated toward the professions.
6. Estimated Selectivity (SEL) – a measure of the ability level of the student body as estimated by dividing the total number of highly able students who want to enroll in the college by the total number of freshmen admitted.
7. Size (SIZ) – based on the total full-time enrollment as reported by the American Council on Education.
8. Realistic Orientation (REA) – the proportion of BA degrees in engineering, agriculture, physical education, forestry, and industrial arts.
9. Scientific Orientation (SCI) – the proportion of BA degrees conferred in the natural sciences, such as physics, chemistry, etc.
10. Social Orientation (SOC) – the proportion of BA degrees in nursing, education, social science, etc.
11. Conventional Orientation (CON) – the proportion of BA degrees in business, accounting, etc.
12. Enterprising Orientation (ENT) – the proportion of BA degrees in public and business administration, advertising, political science, etc.
13. Artistic Orientation (ART) – the proportion of BA degrees in fine arts, languages, etc.

HEW

14. Area – New England (NE)
15. Area – Mideast (ME)
16. Area – Great Lakes (GL)
17. Area – Plains (PL)
18. Area – Southeast (SE)
19. Area – Southwest (SW)
20. Area – Rocky Mountains (RK)
21. Area – Far West (FW)
22. Predominantly black (PN)
23. Public Control (PC)
24. University (UN)
25. Liberal Arts College (LA)
26. Teachers College (TC)
27. Independent Technical (IT)
28. State Control (SC)
29. Local/State Control (LS)
30. Non-Religious/Non-profit (NN)
31. Roman Catholic (RC)
32. Other Religious (OR)
33. Predominantly Male (PM)
34. Predominantly Coed (PC)
35. Land Grant College (LG)

Program Characteristics (PC)

36. Program Type
37. Collocated ROTC

Table 4. Multiple Correlations[a] Between Various Subsets of the Environmental Variables and Selected Enrollment, Production and Cost Criteria

	Detachment Criteria (DC)									
	AS100 ENR		AS300 ENR		No. of Grads		Cost Per Total Det Grad (E)		Total Det Cost (E)	
Predictors	R	R^2	R	R^2	R	R^2	R	R^2	R	R^2
ASTIN	38	14[1,s]	53	28**	57	33**	51	26**	59	35**
HEW	58	34**	57	33**	54	29**	54	29**	65	42**
ASTIN + HEW	67	45**	70	49**	69	48**	64	41**	74	56**

[a]Decimals points omitted.
*Significant at .05 level.
**Significant at .01 level.
ns Non-significant.

To determine whether both sets of predictors would provide a unique contribution to a combined Astin-HEW model, a series of F tests were made in which the predictive accuracy of models containing Astin and HEW variables were compared with that obtained using either the Astin or HEW variables alone. The results of these tests are shown in Tables 5 and 6. In all but one of the comparisons, the combined Astin-HEW models were significantly better than were restricted models using a single component.

Table 5. Regression Analyses to Determine the Independent Contribution of the HEW Variables in the Context of Astin Variables

	R^2				
Criterion	Full[a]	Rest[b]	d_f1	d_f2	F
AS100 ENR	.4466	.1426	17	98	3.17**
AS300 ENR	.4914	.2809	17	117	2.85**
No. of Grads	.4797	.3288	17	117	2.00*
Cost per Grad (E)	.4092	.2554	17	117	1.79*
Total Det Cost (E)	.5552	.3476	17	117	3.21**

[a]Full Model: ASTIN + HEW.
[b]Rest Model: ASTIN.
*Significant at .05 level.
**Significant at .01 level.

Table 6. Regression Analyses to Determine the Independent Contribution of the Astin Variables in the Context of HEW Variables

	R^2				
Criterion	Full[a]	Rest[b]	d_f1	d_f2	F
AS100 ENR	.4466	.3441	13	98	1.40[ns]
AS300 ENR	.4924	.3299	13	117	2.86**
No. of Grads	.4797	.2853	13	117	3.36**
Cost per Grad (E)	.4092	.2891	13	117	1.83*
Total Det Cost (E)	.5552	.4172	13	117	2.79**

[a]Full Model: ASTIN + HEW
[b]Rest Model: HEW.
*Significant at .05 level.
**Significant at .01 level.
[ns]Non-significant.

A final series of comparisons were made to test for the presence of simple curvilinear relationships between the Astin variables and the criteria. For these comparisons, each Astin variable was squared and included as a separate predictor. If the squared terms added significantly to predicted accuracy when compared to models containing Astin variables alone or Astin-HEW variables combined, then the assumption of linearity in relationships would be rejected in favor of a more complex functional form. In none of the comparisons however (as shown in Tables 7 and 8), were curvilinear effects found to be significant.

Table 7. Regression Analyses to Determine the Independent Contribution of Squared Astin Variables in the Context of Astin Variables Alone

	R^2				
Criterion	Full[a]	Rest[b]	d_f1	d_f2	F
AS100 ENR	.2286	.1426	13	102	$.88^{ns}$
AS300 ENR	.3350	.2809	13	121	$.76^{ns}$
No. of Grads	.3972	.3288	13	121	1.06^{ns}
Cost per Grad(E)	.3376	.2554	13	121	1.16^{ns}
Total Det Cost (E)	.4307	.3476	13	121	1.37^{ns}

[a]Full Model: ASTIN + $ASTIN^2$.

[b]Rest Model: ASTIN.

[ns]Non-significant.

Table 8. Regression Analyses to Determine the Independent Contribution of Squared Astin Variables in the Context of Astin and HEW Variables

	R^2				
Criterion	Full[a]	Rest[b]	d_f1	d_f2	F
AS100 ENR	.4868	.4466	13	85	$.51^{ns}$
AS300 ENR	.5506	.4914	13	104	1.05^{ns}
No. of Grads	.5265	.4797	13	104	$.79^{ns}$
Cost per Grad (E)	.4970	.4092	13	104	1.40^{ns}
Total Det Cost (E)	.5950	.5552	13	104	$.78^{ns}$

[a]Full Model: ASTIN + HEW + $ASTIN^2$.

[b]Rest Model: ASTIN + HEW.

[ns]Non-significant.

The analyses to this point have capitalized chiefly on information gained from fully operational detachments. Over the past ten years however, a number of units were disestablished because of failure to meet requisite production standards. Since predictor information was available for these detachments, and effort was made to explore the relationshp between the environmental variables and long-term viability defined as successful versus nonsuccessful during the period 1964–1974. Separate models containing both Astin and HEW variables, and HEW variables alone yielded multiple correlations of .73 and .66, respectively, with the viability criterion. Both of the correlations were significant at beyond the .01 level.

The combined results of these analyses would seem to indicate that the combined Astin-HEW models were the most efficient of those tested for every criterion with the possible exception of *AS100 Enrollments*. To provide a brief summary description of the relationships involved, a matrix of zero–order correlations between the Astin-HEW variables and selected criteria is shown in Table 9. Some caution should be exercised in interpreting these data since each of the coefficients was derived independently of

the others. In general, the pattern of relationships would seem to indicate that successful detachments (i.e., those having relatively high enrollments and production, low unit costs and relatively high probabilities of success), are more frequently located at institutions ranking high on pragmatism, size, and realism and low on status, masculinity, and selectivity. Moreover, detachments tend to be more successful at locations in the Southeast rather than the Northeast, and at publicly controlled universities rather than private liberal arts colleges.

Table 9. Zero-Order Correlations[a] Between Environmental Characteristics and Recent Detachment Performance Criteria

	Detachment Criteria (DC)[b]							
Environmental Characteristics	AS100 ENR	AS300 ENR	Number of Grads	Cost per Grad (E)	Cost per Grade (I)	Total Det Cost (E)	Total Det Cost (I)	Viability 1964–1974
				Astin				
(INT)	–05	–13	–17	07	12	–14	–01	–38
(EST)	–05	03	–03	–01	02	–06	00	–25
(STA)	–03	–14	–16	20	23	–15	–08	–41
(PRA)	15	26	30	–32	–31	35	36	20
(MAS)	–09	–21	–21	10	16	–16	–01	–23
(SEL)	–17	–17	–19	16	24	–23	–04	–38
(SIZ)	08	34	36	–34	–34	30	28	18
(REA)	14	27	28	–32	–32	35	34	25
(SCI)	–02	–12	–10	07	06	–02	–01	–17
(SOC)	–03	–04	–06	08	03	–15	–24	02
(CON)	01	11	17	–06	–01	11	18	16
(ENT)	00	–12	–16	19	22	–14	–08	–27
(ART)	–11	–08	–11	13	12	–17	–23	–24
				HEW				
(NE)	–09	–13	–17	21	23	–17	–16	–24
(ME)	–05	–20	–15	11	14	–18	–09	–25
(GL)	–06	–19	–09	11	10	–07	–04	–02
(PL)	–17	–09	–07	–02	–02	–05	–05	04
(SE)	33	23	22	–09	–11	33	24	20
(SW)	01	14	13	–15	–15	08	06	13
(RK)	–02	08	12	–07	–07	07	05	10
(FK)	–06	13	–04	–05	–06	–11	–10	04
(PN)	19	06	–04	09	03	–01	–08	06
(PB)	13	41	36	–39	–46	42	22	37
(UN)	–09	13	20	–24	–21	14	19	18
(LA)	04	–11	–21	29	28	–20	–21	–22
(TC)	–09	–06	–08	–02	–06	–07	–12	00
(IT)	18	–01	03	00	–02	12	09	03
(SC)	16	43	39	–37	–44	45	26	37
(LS)	–08	–07	–09	–02	–03	–10	–12	00
(NN)	–13	–22	–19	19	26	–21	–05	–55
(RC)	–13	–22	–22	14	18	–24	–14	12
(OR)	08	–17	–13	25	24	–18	–16	08
(PM)	15	–03	–05	03	08	04	–14	–25
(PC)	–15	03	05	–03	–08	–04	–14	25
(LG)	–08	22	24	–26	–28	22	15	27

[a]Decimal points omitted.

[b]These analyses used enrollment criteria from 1973–1974; production and cost data from 1972–1973.

Cross Validation Exercises

In certain applications of these data (as in estimating the suitability of a potential host site), it will be necessary to make inferences about future performance at schools which were not included as part of the validation sample. To evaluate the stability of the environmental (Astin-HEW) equations across time and across institutions, a series of split–sample cross validation exercises was performed. Detachments in continuous operation between 1964 and 1974 were divided into two random half-samples. Estimates of potential error arising solely from criterion variations over time were obtaining by developing models on half-sample 1 (HS1) during a particular time period and cross applying the equations to the same institutions at a later time period. To estimate the influence of institutional variations, equations developed within a particular half-sample were then cross applied to the remaining half-sample in the same time period. By applying these equations to adjacent time periods it was possible to estimate the effects of instability arising from both time and institutional variations. It should be noted that since only half of the sample was used during any of the build-up exercises, the cross-validation estimates that were derived are considered lower-bound in the sense that higher cross validations would be expected if the full-sample equations could be subjected to the same procedure.

The results of these exercises are presented in Appendix B. In general, they suggest that prediction models developed on half-sample data yield significant validities for a majority of near-term criteria when applied cross time, across institutions and across both institutions and time. The inference is made that these same properties would be found in the full-sample equations. For operational purposes, the major implication of these findings concerns the necessity for updating the models as future data become available. In the case of the enrollment and total cost criteria, significant validity seems to be retained for at least 8 years beyond the time the equations are developed. Models predicting graduate production yield significant validity for approximately 4 years beyond development. The equations for the unit cost criteria (including and excluding CSP and FIP) would seem to require updating more frequently; possibly every 2 years.

Analysis of Program Characteristics

Using the environmental variables as control measures, analyses were made to determine if there were any unique effects on the performance criteria attributable to program type or collocation with other detachments. In the comparisons, the collocation variable was coded 1 if the detachment was collocated with other Army or Navy units and zero otherwise. Program type was coded 1 if only AS300 and AS400 were offered (two-year only) and zero if four-year programs were available. Starting models containing both environmental and program variables were compared with restricted models containing only the environmental variables. Failure to find significant differences in predictive accuracy associated with the full and restricted models would indicate that neither collocation nor program type influenced the criteria when environmental effects had been controlled.

Table 10 shows the results of these comparisons. The program variables made unique contributions in predicting only two of the five criteria: *AS300 Enrollments* and *Total Detachment Costs*. There was no

Table 10. **Regression Analyses to Determine the Independent Contribution of Program Characteristics in the Context of Environmental Characteristics**

Criterion	R^2 Full[a]	R^2 Rest[b]	d_f1	d_f2	F
AS100 ENR[c]	.4480	.4466	1	97	.25[ns]
AS300 ENR	.5537	.4914	2	115	8.02**
No of Grads	.4911	.4797	2	115	1.29[ns]
Cost per Grad (E)	.4305	.4092	2	115	2.15[ns]
Total Det Cost (E)	.5863	.5552	2	115	4.32*

[a]Full Model: ASTIN + HEW + PC.

[b]Rest Model: ASTIN + HEW.

[c]Since "2 year only" detachments were excluded from the AS100 analysis, this comparison involves only the colocation variable.

*Significant at .05 level.

**Significant at .01 level.

[ns]Non-significant.

evidence that collocation or program type significantly effected *AS100 Enrollments*, *Number of Graduates* or *Cost per Graduate*. An inspection of the raw score regression weights obtained in the context of the environmental variables (Table 11) indicate that collocated detachments generally had larger *AS300 Enrollments* and slightly higher *Total Detachment Costs* than did single detachments with comparable environmental resources. Collocation appeared to have little, if any, unique effect on the remaining criteria. Detachments with two-year programs tended to have fewer *AS300 Enrollments* and smaller *Total Detachment Costs* than did comparable detachments offering four-year programs while, again, no differences were noted in *AS100 Enrollments, Number of Graduates* or *Cost per Graduate*.

Table 11. Net Effects of Program Characteristics in the Context of the Environmental Variables

Program Characteristics	Net Increase in Predicted Value[a]				
	AS100 ENR	AS300 ENR	No. of Grads	Cost per Grad (E)	Total Det Cost (E) (In ten thousands)
Collocation	ns[b]		ns	ns	
Collocated		9.9			$1.7
Non-Collocated		0.0			0.0
Program Type	N/A		ns	ns	
4 Year		10.7			$5.5
2 Year		0.0			0.0
Criterion SD	—	15.0	—	—	6.9

Note.— N/A = not applicable.

[a]Based on raw-score regression weights rescaled to an arbitrary baseline of zero.

[b]ns indicates that the unique contribution in the context of the environmental variable was found to be insignificant.

IV. APPLICATIONS

Current Detachments

Results of these analyses have various applications for evaluating detachments currently in the inventory. Historical trends in unit production and costs can be monitored with reference to a quality control roster as illustrated in Table 12. Actual criterion values obtained for each school year between 1963–1964 and 1973–1974 are displayed by detachment. Graduate production from Detachment 001 (Criterion University), for example, ranged from a high of 82 graduates in 1966–1967 to a low of 24 graduates in 1972–1973. Enrollments in AS400 peaked in 1965–1966 at 127 cadets; presently there are 15 enrolled in the senior program. The trend in AS100 enrollments shows a decline from the 1964–1965 period to 1970–1971 with small gains each year thereafter. Information from Detachment 002 (University of Interest) shows consistly lower production and correspondingly higher unit costs during the same reporting period.

The environmental prediction equations applied against the current detachment inventory provides some indication of expected criterion performance controlling for environmental and program characteristics. In Table 13 for example, predicted and actual performance for five detachments have been compared for the most recent production and cost criteria available. Residuals have been provided indicating over- or under-performance controlling for known differences in the predictor variables. It will be noted that even though Detachments C and D each graduated 26 officers, Detachment C produced three more officers than would be expected on the basis of uncontollable features of the environment while Detachment D produced nine less than would be expected. In this case, Detachment C might be said to have capitalized to a greater extent on resources available to it as compared with Detachment D.

Potential Host Site Evaluation

The results of these analyses also have implications for the assessment of potential host sites. The environmental prediction equations developed during the course of the study are generalizable in theory to any potential host for which environmental variables are available. Table 14 shows an array of predicted scores for 15 colleges not presently hosting detachments. Selection of schools with the highest predicted

Table 12. Illustration of a Multi-Year Detachment Quality Control Roster

Detachment	School Year										
	63–64	64–65	65–66	66–67	67–68	68–69	69–70	70–71	71–72	72–73	73–74
Det 001 Criterion University											
NUMBER OF GRADS •	023	026	025	022	024	017	019	022	018	015	N/A
COST PER GRAD (INCL) •	06035	04994	04916	05394	04397	09222	11446	07786	11117	13841	N/A
COST PER GRAD (EXCL) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	06567	09291	11574	N/A
TOTAL DET COST (INC) •	00138874	00114844	00122900	00118668	00105528	00156774	00217474	00171292	00200106	00207615	N/A
TOTAL DET COST (EXC) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	00144474	00167238	000173610	N/A
ENROL AS 4CO (TOT) •	N/A	043	035	035	024	017	021	022	018	017	022
ENROL AS 3CO (TOT) •	N/A	026	021	020	018	022	025	022	019	023	015
ENROL AS 2CO (TOT) •	N/A	051	044	041	037	033	020	025	024	026	017
ENROL AS 1CO (TOT) •	N/A	118	104	069	081	084	069	057	053	031	027
ENROL AS 4CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	022	018	017	021
ENROL AS 3CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	022	018	022	014
ENROL AS 2CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	025	021	025	013
ENROL AS 1CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	051	046	028	021
ENROL AS 4CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	000	000	000	001
ENROL AS 3CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	000	001	001	001
ENROL AS 2CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	000	003	001	004
ENROL AS 1CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	006	007	003	006
Det 002 Unversity of Interest											
NUMBER OF GRADS •	021	026	022	033	029	024	025	017	023	016	N/A
COST PER GRAD (INCL) •	05726	04437	05792	04224	05385	07465	08354	12823	12975	23893	N/A
COST PER GRAD (EXCL) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10257	09131	14736	N/A
TOTAL DET COST (INC) •	00120246	00115362	00127424	00137392	00156165	00179640	00208850	00217991	00298425	00382288	N/A
TOTAL DET COST (EXC) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	00174369	00210013	000235776	N/A
ENROL AS 4CO (TOT) •	N/A	048	042	044	039	031	028	025	024	024	037
ENROL AS 3CO (TOT) •	N/A	030	038	027	027	029	025	023	027	025	037
ENROL AS 2CO (TOT) •	N/A	044	053	102	056	040	032	016	026	040	035
ENROL AS 1CO (TOT) •	N/A	102	196	129	086	079	038	048	035	053	040
ENROL AS 4CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	025	024	024	037
ENROL AS 3CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	023	027	025	036
ENROL AS 2CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	015	024	038	033
ENROL AS 1CO (MALE) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	041	035	047	038
ENROL AS 4CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	000	000	000	000
ENROL AS 3CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	000	000	000	001
ENROL AS 2CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	001	002	002	002
ENROL AS 1CO (FEM) •	N/A	N/A	N/A	N/A	N/A	N/A	N/A	007	000	006	002

Note.– N/A = not available.

Table 13. **Comparison of Actual vs Predicted Criterion Performance Based on Environmental and Program Characteristics**

	AS100 ENR (1973—1974)			AS300 ENR (1973—1974)			No. of Grads (1972—1973)			Cost Per Grad(E) (1972—1973)			Total Det Cost (E) (1972—1973)		
Detachment	Act	Pred	R[a]	Act	Pred	R	Act	Pred	R	Act	Pred	R	Act	Pred	R
Det A	67	66	(+ 1)	55	41	(+14)	60	45	(+15)	6,728	5,348	(+1,380)	40.37	29.81	(+10.56)
Det B	32	51	(−19)	30	32	(− 2)	53	35	(+18)	5,093	8,504	(−3,411)	26.99	26.19	(+ .80)
Det C	63	72	(− 9)	23	23	(0)	26	23	(+ 3)	6,981	14,368	(−7,387)	18.15	18.77	(− .62)
Det D	45	52	(− 7)	38	36	(0)	26	35	(− 9)	10,234	6,721	(+3,513)	26.61	26.05	(+ .56)
Det E	54	31	(+23)	62	34	(+28)	55	34	(+21)	5,640	4,419	(+1,221)	31.02	22.51	(+ 8.51)

[a]Residuals are obtained by subtracting predicted score from actual score.

Table 14. Evaluation of Potential Host Sites

College or University	Predicted Performance				
	AS100 ENR	AS300 ENR	No. of Grads	Cost Per Grad(E) (in thousands)	Viability[a]
School A	**44**[b]	**29**	**30**	13.7	.21
B	6	11	10	12.7	.18
C	39	21	21	**11.6**	.52
D	**50**	8	7	23.3	**−.10**
E	**47**	**33**	**25**	12.9	**−.08**
F	**89**	21	14	21.7	**−.09**
G	**87**	**32**	20	14.8	**.06**
H	41	2	6	29.1	**−.29**
I	35	15	14	13.6	**.11**
J	**78**	**32**	**28**	15.9	**−.01**
K	**66**	**41**	**45**	**5.3**	**−.29**
L	37	19	22	**10.1**	**.11**
M	43	23	**25**	**9.2**	**.05**
N	15	3	3	18.6	**.03**
O	**51**	**32**	**35**	**8.5**	**−.08**
$\bar{X}$ for Dets[c]	44	25	24	11.76	.14

[a]Predicted probability of disestablishment.

[b]Bold face type indicates predicted performance at or above the mean for current detachments.

[c]Based on valid N in the analysis sample.

scores would allow AFROTC management to maximize expected system performance on any one of the criteria or on some composite measure. To illustrate one such approach, the predicted values representing performance at or above the mean for current detachments are shown in bold face type. Among those listed, schools E, J, K, M and O might be considered among the more preferred locations.

V. SUMMARY AND CONCLUSIONS

The principal research findings of this study are:

1. Relatively stable differences between detachments were noted in AS100–AS400 enrollments, graduate production and total cost criteria from 1964 through 1974. Mean correlations between years for these measures ranged from .81 to .96. The *Cost per Graduate* criteria, including and excluding CSP and FIP, were much less consistent across time indicating that these criteria might not be suitable for long range forecasting purposes. The system-wide trends in these data were toward decreasing enrollments and production associated with increasing costs over time.

2. A significant amount of the variance in the 1973–1974 criterion data was attributable to environmental factors largely beyond the control of detachment managers. These included institutional size, selectivity, type and control, the proportion of baccalaureate degrees awarded in selected categories, and geographic location. The documentation of these relationships supported the feasibility of an enhanced evaluation system applicable to both current detachments and potential host sites.

3. An analysis of predictive stability across samples indicated that all of the validity estimates associated with the half-sample equations were overestimated to a certain degree during build-up, due to capitalization on chance relationships. The same would probably be true for the full sample equations although to a lesser extent than was observed with the half-sample data. The cross-validated correlations across schools, while moderate in size, were nevertheless statistically significant beyond the .01 level for all criteria except *Cost per Graduate (I)*. Cross Validations across both schools and time showed some deterioration for most of the criteria. Least affected were estimates associated with AS100, AS300 and *Total Detachment Cost*. Cross validated correlations for *Number of Graduates* declined in a more or less linear fashion over the eight year period. *For Cost per Graduate (I)*, no significant validity was retained

beyond the second year. It was concluded that the necessity for updating the equations at two-year intervals was more critical for *Number of Graduates* and *Cost per Graduate* than for the remaining criteria.

4. Program characteristics (colocation and program type) were found to have significant unique effects in the context of environmental influences for two of the five performance criteria tested. Collocated detachments tended to have larger AS300 enrollments and higher overall operating costs than did single units A comparison of program types (two-year versus four-year) indicated that two-year detachments tended to have fewer AS300 enrollments and smaller operating costs than did comparable detachments offering four-year programs. No evidence was found that program characteristics influenced *AS100 Enrollments, Number of Graduates* or *Cost per Graduate* when differences in environmental characteristics were held constant

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APPENDIX A: NORMATIVE DISTRIBUTIONS OF DETACHMENTS ON SELECTED CRITERIA

Table A1. Detachment Frequencies for AS100 through AS400 Enrollment: 1973–1974

(N = 180 Detachments/2 Operating Locations)

AS100 Enrollment		AS200 Enrollment		AS300 Enrollment		AS400 Enrollment	
Number of Cadets	Detachment Frequency	Number of Cadets	Detachment Frequency	Number of Cadets	Detachment Frequency	Number of Cadets	Detachment Frequency
201+	2	101+	4	101+	1	101+	1
100–200	8	51–100	5	51–100	14	51–100	12
91–100	3	46–50	1	46–50	3	46–50	5
81–90	4	41–45	11	41–45	4	41–45	3
71–80	6	36–40	13	36–40	9	36–40	7
61–70	7	31–35	13	31–35	11	31–35	16
51–60	13	26–30	14	26–30	18	26–30	14
41–50	20	21–25	26	21–25	27	21–25	24
31–40	30	16–20	34	16–20	39	16–20	29
21–30	44	11–15	25	11–15	28	11–15	28
11–20	26	6–10	19	6–10	16	6–10	27
1–10	6	1–5	5	1–5	11	1–5	16
0	2	0	1	0	1	0	0
N/A[a]	11	N/A[a]	11				
Mean	35		22		22		22
SD	34		25		16		18

[a]Includes detachments offering "2 year only" program.

Table A2. Detachment Frequencies for Number of Graduates, Cost per Graduate and Total Detachment Costs: 1972–1973

(N = 184 Detachments)

			Including CSP and FIP	Excluding CSP and FIP		Including CSP and FIP	Excluding CSP and FIP
Number of Graduates	Detachment Frequency	Cost Level[a]	Detachment Frequency	Detachment Frequency	Cost Level[a]	Detachment Frequency	Detachment Frequency
71+	3	31.5+	11	8	700+	1	1
66–70	1	29.5–31.4	3	0	650–699	0	0
61–65	1	27.5–29.4	2	2	600–649	1	0
56–60	1	25.5–27.4	3	3	550–599	6	1
51–55	4	23.5–25.4	7	3	500–549	5	0
46–50	6	21.5–23.4	5	2	450–499	3	0
41–45	5	19.5–21.4	8	3	400–449	5	2
36–40	7	17.5–19.4	10	7	350–399	9	4
31–35	12	15.5–17.4	15	9	300–349	26	4
26–30	17	13.5–15.4	23	12	250–299	24	16
21–25	13	11.5–13.4	19	19	200–249	45	44
16–20	30	9.5–11.4	21	29	150–199	29	53
11–15	33	7.5– 9.4	29	31	100–149	21	44
6–10	23	5.5– 7.4	11	34	50–99	1	1
1–5	14	3.5– 5.4	3	8	N/A	14	14
0	14	N/A	14	14			
Mean	21		16.6	13.3		267	203
SD	19		12 4	10.0		127	88

Note. — N/A = not applicable.

[a]n in thousands.

APPENDIX B: HALF-SAMPLE CROSS-VALIDATION EXERCISES

The first row of correlations in Table B1 indicates that a multiple correlation of .74 was obtained using Astin-HEW variables to predict *AS100 Enrollment* (1964–1965) based on data from half-sample 1. Correlations of predicted scores base on this model with criterion data from the same schools over the next eight years decreased in magnitude from .63 in T+2 to .34 in T+8. Application of weights developed in HS1 to HS2 data in the same year produced a multiple R of .49. Cross-correlations with data from subsequent years ranged from .45 in T+2 to .34 for T+8. Models developed for data in later years yielded build-up and cross validated R's in the same general range as those found for the 1964–1965 data. To summarize the accuracy of these models across time and schools, the mean correlations for each column have been provided in the last row of the table. Statistical tests revealed that all but one of the cross-validated R's was significant at or beyond the .05 level.

Half-sample cross validations for *AS300 Enrollments* and *Number of Graduates* (Tables B2 and B3) were similar to those found with *AS100 Enrollments*. For the graduate criteria, there did seem to be a tendency for the models to deteriorate more rapidly over time. The mean correlations for T+6 and T+8 were non-significant. It also appeared as if models generated on more recent criteria were more accurate in the cross validation exercises. In contrast to the enrollment and production criteria, models developed to predict *Cost per Graduate (I)* (Table B4) retained almost no validity beyond the second year. Although based on more limited data, models developed to predict *Cost per Graduate (E)* appeared somewhat more stable as shown in Table B5. Cross validation of equations to predict detachment *Viability* during the period 1964–1974 (Table B6) yielded validities of .55 for the Astin-HEW models and .61 for the HEW variables alone. Both were significant beyond the .01 level.

Table B1. **Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs AS100 Enrollment**

School Year T	Build Up	Cross-Validated R's								
			Across Time			Across Schools	Across Schools and Time			
		T+2	T+4	T+6	T+8	T	T+2	T+4	T+6	T+8
1964–1965	74	63	55	48	34	49**	45**	40**	44**	34**
1966–1967	75	68	62	40		35**	26*	35**	37**	
1968–1969	75	72	40			28*	31*	39**		
1970–1971	86	43				34**	23^{ns}			
1972–1973	87					26*				
Mean Correlation	80	63	53	44	34	35**	32**	38**	41**	34**

[a]Decimal points omitted.

*Significant at .05 level.

**Significant at .01 level.

^{ns}Non-significant.

Table B2. Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs AS300 Enrollment

School Year T	Build-Up	Cross-Validated R's: Across Time T+2	T+4	T+6	T+8	Across Schools T	Across Schools and Time T+2	T+4	T+6	T+8
1964–1965	85	76	74	63	50	21^{ns}	34**	36**	32**	31**
1966–1967	85	77	70	49		40**	42**	37**	30**	
1968–1969	83	74	58			42**	39**	39**		
1970–1971	81	69				38**	37**			
1972–1973	85					39**				
Mean Correlation	84	74	68	56	50	36**	38**	37**	31**	31**

[a]Decimal points omitted.
*Significant at .05 level.
**Significant at .01 level.
[ns]Non-significant.

Table B3. Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs Number of Graduates

School Year T	Build-Up	Cross Validated R's: Across Time T+2	T+4	T+6	T+8	Across Schools T	Across Schools and Time T+2	T+4	T+6	T+8
1964–1965	85	77	72	69	56	14^{ns}	06^{ns}	20^{ns}	15^{ns}	10^{ns}
1966–1967	88	73	64	51		13^{ns}	29*	22^{ns}	20^{ns}	
1968–1969	85	76	62			35**	32**	27*		
1970–1971	84	66				42**	42**			
1972–1973	81					43**				
Mean Correlations	85	73	66	61	56	30**	28*	23*	18^{ns}	10^{ns}

[a]Decimal points omitted.
*Significant at .05 level.
**Significant at .01 level.
[ns]Non-significant.

Table B4. Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs Cost per Graduate (Incl)

School Year T	Build-Up	Cross-Validated R's: Across Time T+2	T+4	T+6	T+8	Across Schools T	Across Schools and Time T+2	T+4	T+6	T+8
1964–1965	87	56	51	01	01	-13^{ns}	09^{ns}	11^{ns}	04^{ns}	-04^{ns}
1966–1967	78	58	01	01		05^{ns}	34**	01^{ns}	06^{ns}	
1968–1969	82	29	23			16^{ns}	20^{ns}	02^{ns}		
1970–1971	84	62				30**	29*			
1972–1973	51					21^{ns}				
Mean Correlation	79	52	26	01	01	12^{ns}	23*	05^{ns}	05^{ns}	-04^{ns}

[a]Decimal points omitted.
*Significant at .05 level.
**Significant at .01 level.
[ns]Non-significant.

Table B5. Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs Cost per Graduate (Excl)

School Year T	Build-Up	Cross-Validated R's: Across Time T+1	Across Time T+2	Across Schools T	Across Schools and Time T+1	Across Schools and Time T+2
1970–1971	81	44	55	28*	20^{ns}	29*
1971–1972	76	34		32**	38**	
1972–1973	80			21^{ns}		
Mean Correlation	79	39	55	27*	29*	29*

[a]Decimal points omitted.
*Significant at .05 level.
**Significant at .01 level.
^{ns}Non-significant.

Table B6. Multiple Correlations[a] Obtained During Split-Sample Cross-Validation Exercises: Environmental Characteristics vs Detachment Viability (1964–1974)

Predictors	Multiple Correlations: Build-Up	Cross-Validation
Astin + HEW	78**	55**
HEW only	64**	61**

[a]Decimal points omitted
*Significant at .05 level.
**Significant at .01 level.

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